

A NEW LACEWING-FLY (NEUROPTERA: PLANIPENNIA) FROM CANADIAN CRETACEOUS AMBER, WITH AN ANALYSIS OF ITS FORE WING CHARACTERS¹

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ABSTRACT: A new genus and species of lacewing-fly, tentatively assigned to the family Berothidae, preserved in Canadian Upper Cretaceous amber is described and illustrated. This constitutes the first North American fossil record of berothid-like Neuroptera. The fore wing venation of this species is analyzed and compared with those of other groups of recent and fossil Neuroptera.

The principal objective of this paper is to describe a previously unknown fossil lacewing-fly and to compare its characters, mostly those of the fore wing, with homologous characters of extant groups. The study is based on an unique fossil specimen preserved in Canadian amber and deposited in the Canadian National Collection of Insects, Ottawa. It was found in July, 1971, by Dr. J.F. McAlpine in the tailings of an open-pit coal mine near Medicine Hat, Alberta, where amber-bearing coal deposits are overlaid by Upper Cretaceous bentonites estimated as being 72-73 million years old (Richards 1966, McAlpine & Martin 1966). According to McAlpine and Martin (1966) it is very likely that insect specimens collected at the same site existed before the close of the Campanian epoch, some 81 million years ago.

The environmental conditions in Upper Cretaceous times in North America generally, and in Alberta in particular, have been briefly summarized by Richards (1966). According to him, "toward the end of the Cretaceous, the climate in North America was becoming more temperate, although evidently still mainly tropical . . . , the great inland sea was being drained by successive uplifts that gave rise to the present Rocky Mountains, and angiosperms were becoming established as the dominant flora ... In southern Alberta the climate was probably still mainly tropical." Since the current climatic conditions in Alberta are drastically different from those prevailing in Upper Cretaceous times, it is not surprising that this and other amber species show a rather remote similarity to those now extant in the region.

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There are two principal kinds of continental North American amber having insect inclusions. The younger is of Tertiary age, dated as Oligocene and Miocene (Hurd *et al.* 1958) and estimated at 30 to 35 million years old; it is known from Mexico (Chiapas)³, and is slightly younger than Baltic amber (Petrunkévitch *et al.* 1963). The older is of Cretaceous age, 72 to 81 million years old (Carpenter *et al.* 1937, Hurd *et al.* 1958, McAlpine & Martin 1966, 1969) and is known mostly from the northern parts of the continent. It is known from several sites in Canada, from Alaska, and in the contiguous United States from New Jersey, New York, Tennessee and also from Colorado (Carpenter *et al.* 1937). In Canada the following are the amber sites most explored for insect inclusions: Alberta, near Medicine Hat; British Columbia, Nanaimo Coalfields, Nechako River, Peace River and Frances River; Manitoba, Cedar Lake near mouth of the Saskatchewan River; Saskatchewan, southern part (Carpenter *et al.* 1937). In Alaska, Cretaceous Arctic amber was discovered on the slopes of the Arctic Ocean near Point Barrow and has been collected in great quantities in beach drift along the Kuk River (Hurd *et al.* 1958). The North American Cretaceous amber containing fossil insects is of much more interest than either Tertiary amber from the Baltic, or the even younger samples from Mexico, because the Cretaceous period was of far greater significance in insect evolution (Carpenter 1937, Hurd *et al.* 1956).

It is unfortunate that the specimen herein described constitutes the only record of a neuropteroid insect from North American amber. There are, nevertheless, some records of Neuroptera, including Berothidae, Sisyridae and/or Neurothidae from Baltic amber to which attention may be drawn (Hagen 1854, 1856; Handlirsch 1906-1908; Krüger 1923a, 1923b; Parfin & Gurney 1956; Martynova 1962⁴; MacLeod 1970; Henning 1981). All those known and all extant genera, however, appear to differ in certain significant features from the specimen treated here.

³Tertiary amber with insect fossil inclusions is also known from the Caribbean region, notably the Dominican Republic.

⁴There is an illustration by Martynova (1962: 281) of a "mysterious" apparently spurious, allegedly extant European species "*Sisyra flavicornis* Linnaeus," in which the fore wing is shown clearly as possessing a humeral vein. This seems to be the only record of such a vein in a recent sisyrid. We have not yet discovered what was meant by Martynova, since Linnaeus never described any neuropteroid species under the name *flavicornis*. Based upon venation and distribution of thyridia it is very likely that the illustration by Martynova (1962) represents an aberrant *Symphorobius*. Comstock (1918: 178) also illustrated the wings of *Sisyra flavicornis*?, a species occurring in "British India," but did not specify the name of the original author. On his illustration, the humeral recurrent vein is lacking in the fore wing.

***Plesiorobius*, new genus**

Figs. 1, 2

Type species: *Plesiorobius canadensis*, new species**Diagnosis**

This genus is distinguished by the following combination of characters: dorsum of head, pronotum and thorax with long, protruding setae; antenna moderately short (28 to 30 segments) approximately as long as half of the fore wing; apical segment of each maxillary and labial palpus elongate, narrow basally, cylindrical as far as middle, then tapering apically to an acute point; clypeus and labrum slightly protruding; fore wing with veins unicolorous and bearing evenly distributed pubescence; humeral recurrent vein (Vr) present; costal veinlets numerous, forked or single; subcosta (Sc) coalesced with first branch of radius (R₁) at the apex; subcostal area between Sc and R₁ without any apparent cross-vein; R₁ and R₅ connected by a single cross-vein located in apical third; R₅ with five main branches (R₂-R₆); basal piece of anterior media (MA) present and located between R₅+MA and base of posterior media (MP); numerous outer and inner gradate cross-veins present between branches of R₅ and MA + MP.

Description

Body: small (ca. 3.5 mm long), pubescent, brownish to yellowish. **Head:** antenna with about 28 to 30 segments, moderately short, reaching to second abdominal tergum, scape elongate, robust, three following segments slightly elongate; maxillary palpus 4- or 5-segmented, with apical segment elongate, narrow basally, cylindrical as far as middle, then tapering apically to an acute point; labial palpus with apical segment similar in shape to that of maxillary palpus; clypeus and labrum protruding. **Thorax:** large, pronotum with lateral lobes appearing to be triangularly produced. **Legs:** elongate and pubescent, with 5-segmented protarsi, basal segment the longest, segments 2 and 3 slightly shorter, segment 4 the shortest, segment 5 terminating in paired simple claws. **Wings:** fore wing elongate-oval with rounded, though slightly pointed apex; veins with long, evenly distributed pubescence; costal area widest in basal third, narrower elsewhere; humeral recurrent vein (Vr) present; costal veinlets numerous, forked or single; subcosta (Sc) sinuate, terminating in first branch of radius (R₁); latter long, coalesced basally with anterior media and radial sector (MA + R₅); R₁ and R₅ connected by a single cross-vein located in apical third; R₂ with five branches (R₂ - R₆), MA coalesced basally with R₅; posterior media (MP) with two main branches coalesced basally; a short basal cross-vein (basal piece of MA) present between R₅ + MA and base of MP; anterior cubitus (CuA) with four main branches; posterior cubitus (CuP) deeply forked; numerous outer and inner gradate cross-veins present between branches of R₅, and medial (MA and MP) and also cubital (CuA and CuP) veins; hind wing not properly known. **Abdomen:** 10-segmented with tergal sclerites markedly reduced; terminalia of not clearly determined sex (Fig. 2) as follows: tergum IX small; tergum X (ectoproct) appearing as a more or less rounded plate with a large, centrally located trichobothrium; two additional overlapping oval structures are apparently displaced dorsally (Fig. 2); a single elongate structure with forked apex is located ventrally, its affinity is not known at present.

***Plesiorobius canadensis*, new species**

Figs. 1, 2

Holotype (sex undetermined): Canada, Alberta, near Medicine Hat, in amber collected from tailings at open pit coal measure, July 8-11, 1971, J.F. McAlpine coll., Type No. 18446;

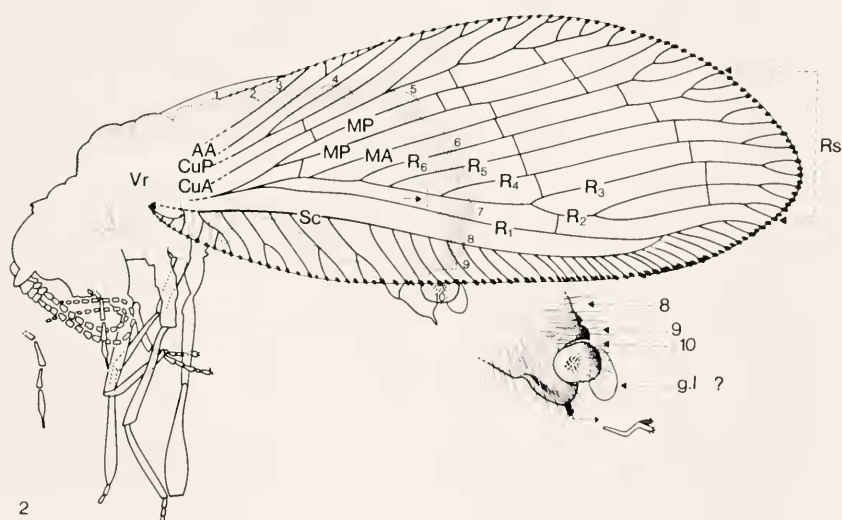


Fig. 1. *Plesiorobius canadensis* n. gen., n. sp., in Canadian amber (reproduced from a color slide made by Mr. T. Stovell, formerly of the Biosystematics Research Institute, Agriculture Canada, Ottawa).

Fig. 2. Outline drawing of *Plesiorobius canadensis* n. gen., n. sp., with enlargement of terminal segments of abdomen and maxillary palpus. AA, anal anterior; CuA, cubitus anterior; CuP, cubitus posterior; g.l., probably gonapophyses laterales; MA, media anterior; Sc, subcosta (=subcosta anterior + subcosta posterior); Rs, radial sector; R₁ to R₆, radial veins; Vr, humeral recurrent vein.

deposited in Canadian National Collection of Insects, Ottawa.

Description

Body: small, approximately 3.5 mm in length, yellowish-brown with long pubescence. **Head:** moderately large, with elongate vertex and protruding clypeus and labrum; maxillary palpus with only 4 segments clearly visible (though 5 could be present); labial palpus with only apical segment clearly visible. **Thorax:** pronotum with triangular lateral lobes bearing numerous setae; meso- and metanota well developed, with long dorsal pubescence. **Wings:** fore wing (Figs. 1, 2) 5.0 mm long, maximum width 1.7 mm, narrowly oval with a rounded but slightly pointed apex, transparent without maculations, veins unicolorous and bearing long setae, costal area widest in basal third, narrower elsewhere; first branch of radius (R_1) long, branching from combined base of radial sector and anterior medial vein ($R_s + MA$); R_s with 5 principal branches (R_2 - R_6); one cross-vein present between R_1 and R_s located apically; hind wing not clearly seen. **Abdomen** (including terminalia) as given under generic description.

DISCUSSION

The only family to which our fossil insect may provisionally be assigned is the Berothidae of Handlirsch. It may be distinguished from all previously known berothids, however, mainly by the fore wing having a more distinct recurrent humeral vein, by the lack of any cross-vein between Sc and R_1 , and by having but a single cross-vein between R_1 and R_s , regularly distributed outer and inner gradate cross-veins and more branches to the radial sector. It also differs in possessing characteristic abdominal terminalia (presumably female).

It is possible that the vein which we have named MA might eventually prove to be the last branch (R_7) of R_s . Furthermore, the hind wing can be only very poorly seen, so that it can not be adequately studied until more advanced computerized X-ray techniques become available. At present, therefore, it is not possible to state with certainty whether or not the specimen is indeed a berothid, true Berothidae having the posterior cubital region of the hind wing highly specialized. The specialization takes the form of a long series of short veinlets reaching the posterior margin of the wing. In the absence of such specialization, *Plesiorobius* would presumably have to be assigned to a new subfamily or even a family representing an extinct sister-group of the main berothid stock comprising all presently recognized subfamilies of Berothidae.

We have associated our Cretaceous insect with the Berothidae on the basis of the following shared characteristics: presence of a recurrent humeral vein⁵; Sc ending on R_1 ; R_s with numerous branches and

⁵The recurrent humeral vein of *Plesiorobius* is better developed than in the majority of Berothidae except that of *Naizema* Navás (for details see MacLeod and Adams 1967).

proximally separated from R_1 ; presence of a distinct cross-vein between R_5 and the medial vein, deeply forked CuP , and similarly arranged remaining principal veins. For the present, however, we refrain from erecting a new family or subfamily to accommodate it in view of the currently rather unstable nature of the higher classification of the recent Neuroptera which does not fully take into account many fossil groups.

It is interesting to note that the fore wing of *Plesiorobius* also resembles, to a certain degree, that of the fossil *Palaemerobius proavitus* described by Martynov (1928) from the Permian beds of European U.S.S.R. Both have similar radial sectors proximally separated from R_1 . *Palaemerobius* is distinctive, however, in lacking a recurrent humeral vein, and by having several cross-veins between R_1 and R_5 and fewer and rather irregularly distributed outer and inner gradate cross-veins. Tillyard (1932) pointed out some characters which might serve to link *Palaemerobius* with the Berothidae (most of the discussion, however, pertains to a comparison of *Palaemerobius* with the Glosselytrodean, *Pernoberothes*).

Plesiorobius also shares certain characteristics with both Neurorthidae (as defined by Nakahara 1958, Zwick 1967, Riek 1970, Richards and Davies 1977, Aspöck, *et al.* 1980), and Sisyridae (as defined by Killington 1936, Carpenter 1940, Parfin and Gurney, 1956, Aspöck *et al.* 1980). All have R_5 pectinate and proximally separated from R_1 , and MP deeply forked and reaching the upper level of $R_5 + MA$. We are unable, however, to find in *Plesiorobius* any sign of nygmata (sensory spots usually occurring between posterior branches of R_5 or between R_5 and MA) in the fore wing. This character, according to Riek (1970)⁶ and Richards and Davies (1977) is not only characteristic of the family Neurorthidae, but is of major significance in the higher classification of Neuroptera. Both authorities cited, mainly on the basis of the presence of nygmata, grouped Neurorthidae, Osmylidae and Ithonidae in a single superfamily, the Osmyloidea, and certain other families lacking these structures, namely Berothidae, Sisyridae and Mantispidae in another, the Mantispoidea. Aspöck *et al.* (1980), however, have a somewhat different opinion regarding the relationships, claiming that the Neurorthidae and Osmylidae combined constitute a sister-group of the Sisyridae. This conflicts with the superfamily concept of Riek (1970) and Richards and Davies (1977). The Sisyridae cannot, on the one hand, be placed together with the Berothidae and Mantispidae in one superfamily (Mantispoidea of Riek 1970, and Richards and Davies 1977), while being at the same time a sister group of Neurorthidae-Osmylidae plus Ithonidae in another (Osmyloidea). Although we have not examined actual

⁶Riek (1974) slightly re-evaluated his former view (Riek 1970) on the higher classification of Neuroptera stating that the nygmata represent a plesiomorphic condition and that the superfamily Osmyloidea requires subdivision.

specimens of Neurorthidae, we have thoroughly studied the relevant literature (Krüger 1923b, Eben-Petersen 1929, Nakahara 1958, Zwick 1967, Riek 1970, Aspöck *et al.* 1978, Aspöck *et al.* 1980), and are of the opinion that *Plesiorobius* is not closely related to the Neurorthidae or Osmylidae, whatever may be the phylogenetic relationships of the above-mentioned families. The Ithonidae and Mantispidae are both too remote in their relationship to be of concern in the present discussion, but the Sisyridae are not far from the Berothidae.

There are three species of Berothidae known from inclusions in amber: *Proberotha prisca* Krüger (1923a) from Baltic amber and recently described *Banoberotha enigmatica* Whalley and *Paraberotha acra* Whalley (1980), from the Lower Cretaceous amber of Lebanon. The above mentioned fossil berothids bear rather remote resemblance to our fossil insect and apparently represent different evolutionary lineages. Furthermore, as far as known, Krüger's specimens are missing.

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